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MOST COMPUTER SYSTEMS: SHIPYARD APPLICATIONS

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ABSTRACT

An overview of the Most Computer System is presented, as it may best be applied in the shipyard, including the structure of time data for shipyard use. The simplicity and ease of preparing methods improvements with the computer aided materials are outlined, and finally, examples from shipyard applications are reviewed.

One of the basic needs in the shipbuilding industry is to know the true work content for each ship --- preferably in advance. Because of the "one of a kind" nature of shipbuilding, time study was considered to be useless as a general tool for defining work content in advance of construction. Predetermined time data - as it became available - provided the opportunity to define work content in advance of manufacture -- but the number of analyst hours required to define each hour of work was so high, that it was still considered impractical or uneconomical to use the systems. Nevertheless, the basic need for measure of true work content - as opposed to historical data - remained.

The use of predetermined time data to build standard data through tables and formulas was a further step towards reducing analyst time, and the fact that many basic operations were repetitive (such as the welding of panels) helped to reduce again the analytical time -- but it was considered to be too high.

The development of the Maynard operation sequence technique (MOST) brought us a work measurement technique that was specifically designed to accomodate long-cycle, non-repetitive types of work. When MOST was combined with the work management manual approach to recording and reporting data, it began to be feasible to measure the work content of the shipbuilding process. However, there were still two tasks that involved a considerable amount of manual effort: searching the files for existing reusable data, and totalling the "bits" of time into the large number of hours required for segments of a ship.

MOST Computer Systems has finally brought us to the stage of development that reduces the manual efforts of recall and summation -- plus! we believe that today we have a well defined work measurement system that is practical and economical for shipbuilding purposes.

SNAME Panel SP-8 on Industrial Engineering has provided the impetus and support necessary to implement MOST Computer Systems. As a result, we are getting the hands on experience needed to prove the value of MOST Computer Systems in the shipyard.

Incidentally, some of you who have had exposure to the Japanese shipbuilding techniques may feel that the industrial engineering program is extraneous -- since the successful Japanese Yards do not have an I.E. function. At this POI presentation, I will point out the fallacies in that evaluation.

MOST COMPUTER SYSTEMS - AN OVERVIEW

Last year at the IREAPS Conference, Maynard gave a detailed review of MOST and we will not attempt to go over all that ground today. In a quick review, MOST uses a family of six descriptive sequences to define manual operations, the use of tools, and the use of cranes and trucks for material handling. By using specific key words and a well defined sentence structure, a computer program has been prepared that permits an analyst to "write" the method as it is performed in a defined work area. The computer applies the proper sequence and the time values to the written method steps.

Before describing the basic procedure, let's look at the total program package that makes MOST Computer Systems.

There are five basic system programs and six supplementary modules programs that may be combined to provide the most usable system for a given situation. The programs are:

A. Basic Programs

1. MOST Analysis - The preparation of work area layouts and the methods description.

2. Suboperations Data Base - A file of completed method descriptions in suboperation and/or combined suboperation form.

3. Time Standard - The preparation of actual labor standards.

4. Standard Data Base - Same function as suboperations data base, except that complete standards are filed.

5. Mass Update - A program that permits overall modification of the time standards for the change of a common factor.

B. Supplementary Modules

1. Machining Data - The preparation of machining process times.

2. Welding Data - The preparation of welding process times.

3. Line Balancing - For complex assembly line operations.

4. Multi-man Machine Analyses - For making the best use of labor resources.

5. Word Processing - A program used for text and form preparation. A version of the program is specifically designed to prepare work management manuals.

6. Labor Reporting - for keeping track of labor utilization.

THE MOST PROGRAM

The MOST program itself is, of course, the basic tool for time standard preparation. The program consists of two specific parts.

A. The work area layout, and

B. The method description.

The work area layout is a simple block diagram of the work area involved. Within the work area, we define workplaces (each location where work is performed such as a work bench, a machine, a storage rack, a space on the platen, etc.) and the things we find at the work places - such as the operator, pallets, tools, the objects we will be working with, and the equipment. Finally, we define the physical relationships or distances between each workplace. Figure 1 is an example of a work area in a fabrication shop where we will be bending brackets.

With the work area coded and defined, we are ready to write the method for a job in that area. Each method or suboperation is first coded and titled in accordance with a set of rules that has been established to simplify recall and future use of the suboperation.

Figure 2 is an example of a method for bending brackets in the work area illustrated in Figure 1. The program incorporates a tracking system that simplifies the way we describe a method step, and the operator, the objects and the tools are automatically traced from one workplace to another - or from a workplace to an operator or vice versa.

Figure 1

```
                        FABRICATION-SHOP-JOGGLER

            ------------
            !          !
            !          !
 ------    PRESSING-BLOCK
 !    !     !          !
 CONTROL-BOX ------------
 ------   ---------------(X)
          !              !
       (X)!              !(X)
          !              !
          !   JOGGLER    !
          !              !    ----------    ----------    ----------
          !              !    ! FIN-BIN !   !IN-PALLET!   !CRANE-REST
          ---------------    ----------    ----------    ----------
```

Name	Location		Body/Frag/PT
WORKPLACES:			
CRANE-REST	60,0	10,2	
JOGGLER	10,0	15,7	
PRESSING-BLOCK	12,8	11,5	
CONTROL-BOX	0,7	5,3	
FIN-BIN	30,0	10,2	BEND
IN-PALLET	45,0	10,2	
FABRICATION-SHOP-JOGGLER	35,19	0,0	
TOOLS:			
PROFILE-GAUGE	JOGGLER		
PENCIL-1	JOGGLER		
PAINT-STICK	JOGGLER		
PENCIL-2	CONTROL-BOX		
OBJECTS:			
DIE	JOGGLER		
JOB-CARD	JOGGLER		
MATERIAL-CARD	CONTROL-BOX		
BRACKETS	IN-PALLET		FRAG
EQUIPMENT:			
JIB-CRANE	CRANE-REST		30 FPM 2J
BUTTONS	CONTROL-BOX		
LEVER	CONTROL-BOX		
OPERATORS:			
CRANE-OPERATOR	JOGGLER		27,5 B
MECHANIC	JOGGLER		8,5
HELPER	JOGGLER		27,7

From	To	Steps
CRANE-REST	JOGGLER	8
CRANE-REST	PRESSING-BLOCK	8
CRANE-REST	CONTROL-BOX	14
CRANE-REST	FIN-BIN	4
CRANE-REST	IN-PALLET	2
CRANE-REST	FABRICATION-SHOP-JOGGLER	0
JOGGLER	PRESSING-BLOCK	0
JOGGLER	CONTROL-BOX	2
JOGGLER	FIN-BIN	2
JOGGLER	IN-PALLET	4
JOGGLER	FABRICATION-SHOP-JOGGLER	0
PRESSING-BLOCK	CONTROL-BOX	2
PRESSING-BLOCK	FIN-BIN	2
PRESSING-BLOCK	IN-PALLET	4
PRESSING-BLOCK	FABRICATION-SHOP-JOGGLER	0
CONTROL-BOX	FIN-BIN	8
CONTROL-BOX	IN-PALLET	10
CONTROL-BOX	FABRICATION-SHOP-JOGGLER	0
FIN-BIN	IN-PALLET	2
FIN-BIN	FABRICATION-SHOP-JOGGLER	0
IN-PALLET	FABRICATION-SHOP-JOGGLER	0

Flgure 2

The Title is:

BEND FLANGE ON BRACKET AT JOGGLER
PER EACH OFG: 1 IO-SEP-B1

OPerator ? CRANE-OPERATOR

Begins at WorkPlace ? JOGGLER

Method Step 1 ? CRANE-OPERATOR TRANSPORT BRACKET FROM IN-PALLET USING JIB-CRANE WITH TWIN-HOOK FREEING+LOOSE RAISING 5 FT. TO JOGGLER LOWERING 1 FT. AND ALIGN+ ACCURATE AND RETURN JIB-CRANE TO IN-PALLET

Al6 TlO K24 F3 V32 L16 V6 F16 T16 A0 1.00 1390.‘

Method Step 2 ? MECHANIC PICKUP MATERIAL-CARD
A3 BO Gl Al BO PO A0 1.00 50.

Method Step 3 ? MECHANIC READ 10 WORDS
A0 BO GO A0 BO PO T6 A0 BO PO A0 1.00 60.

Method Step 4 ? MECHANIC HOLD+MOVE MATERIAL-CARD TO CONTROL-BOX
A0 BO GO Al BO P1 A0 1.00 20.

Method Step 5 ? MECHANIC PUSH BUTTONS AT CONTROL-BOX PTIME .5 S
Al BO Gl Ml Xl IO A0 1.00 . . 40.

Method Step 6 ? MECHANIC SLIDE LEVER AT CONTROL-BOX PTIME 2.5 S (LIFTING PRESS ING BLOCK)
Al BO Gl M3 X6 IO A0 1.00 110.

Method Step 7 ? HELPER PUSH BRACKET AT DIE AND ADJUST
A1 BO Gl Ml X0 16 A0 1.00 90.

Method Step 8 ? MECHANIC SLIDE LEVER AT CONTROL-BOX PTIME 4 .5 S (FLANGING BRAC KET) F 3
Al BO Gl M3 X10 IO A0 3.00 450,

Method Step 9 ? MECHANIC SLIDE LEVER AT CONTROL-BOX PTIME 2.5 S (LIFTING PRESS ING BLOCK) F 3
Al BO Gl M3 X6 IO A0 3.00 330.

Method Step 10 ? HELPER MEASURE FLANGE AT JOGGLER USING PROFILE-GAUGE AND ASIDE F3
Al BO Gl Al BO Pi Ml0 Al BO Pl A0 3.00 480.

Method Step 11 ? MARK BRACKET AT JOGGLER 13 DIGITS USING PAINT-STICK AND ASIDE
Al BO Gl Al BO Pi R42 Al BO Fl A0 1.00 480

Method Step 12 ? HELPER GET+PLACE BRACKET FROM JOGGLER TO FIN-BIN AND HELPER RET URN JOGGLER
- Al BO G3 A3 B6 P3 A3 1.00 190.

Method Step 13 ? MECHANIC MARK JOB-CARD 7 DIGITS USING PENCIL-1 AT JOGGLER AND A SIDE (SiGNATURE / DATE)
A3 BO Gl Al BO Pl R24 Al BO Pl A0 1-00 320 .

Method Step 14 ? EX

Total TMU 4010.

If it is desirable to review the feasibility of a work area arrangement, you have the flexibility of editing an existing work area by changing distances, or workplace locations, or by adding tools, etc. You may then use the same method steps and get the new or revised time frame without having to rewrite the method, or you may edit the method description for the same effect. You have a simple tool for testing and evaluating methods changes without the manual effort of rewriting and preparing hard copy.

If the work area has been properly defined, you may associate almost any number of suboperations with a given work area.

The end result of the MOST program, then, is a number of work area layouts, with the associated methods descriptions or suboperations. Naturally, it is most desirable to define a suboperation as a unit of work that is repetitive in nature so that you may take the maximum advantage of the filing system described next.

THE DATA BASE

Once the analyst - or user - has created a work area and a suboperation, the next step is to file the completed work in a permanent file where it can be readily accessed. That file is the data base. A suboperation like "place tube in bender" will be the same for many sizes of tubing, and for almost any subsequent bending operation. When we have the suboperation in the data base, we want to be able to recall it at any time we may need it.

By using a well defined title procedure for each suboperation, with a restricted and defined word list for title components, we are able to create a search routine that will enable us to recall any filed suboperation.

There are ten basic components to the title structure -- as follows:

1. ACTIVITY - A verb that describes the overall action being carried out, such as: BEND, BURN, or WELD.

2. OBJECT/ASSEMBLY/COMPONENT - A noun that describes the item receiving the action - such as: Bend TUBE, burn LIGHTENER HOLE, or weld STIFFENER.

3. "IN", "ON" "FOR" - You select the appropriate preposition.

4. PRODUCT/EQUIPMENT/ASSEMBLY - The item that the object is a part of, such as: bend tube for BOILER, burn lightener hole in WEB, or weld stiffener on DECK PANEL.

5. "WITH"

6. TOOL - The actual tool being used to accomplish the activity: bend tube for boiler with BENDER, burn lightener hole in web with TRACER BURNER, or weld stiffener on deck panel with MIG.

7. "AT" , "TO" - You select the appropriate word.

a. SIZE/CAPACITY/TYPE - A modifier for the next segment:
Bend tube for boiler with bender at #875...
Burn lightener hole in web with tracer burner at OPTICAL...
Weld stiffener on deck panel with mig at #1...

9. ORIGIN - Specifies the work area or machine where the work is done:

bend tube for boiler with bender at 3875 GREENLEE...

burn lightener hole in web with tracer burner at optical BURNER...

weld stiffener on deck panel with mig at #1 WELD STATION...

10. MACHINE # OR WORK PLACE # - Specification of the exact machine or location involved:

bend tube for boiler with bender at #875 greenlee SHOP70

burn lightener hole in web with tracer burner at optical burner HARDINGE.

weld stiffener on deck panel with mig at #1 weld station PLATEN 2.

An individual designated as the data coordinator is assigned the task of filing each suboperation in the data base. He does not review the analyst's work, but does review the suggested title for completeness and accuracy. He files the suboperation in the data base after making sure that the title is correct and complete, and that the suboperation is not a duplication of something already in the data base. The computer will automatically assign a sequential locator number for use in future recall actions.

Once filed in the data base, the suboperation is available to all users. A user may search the data base by part or all of the title, and will be able to review some number of suboperation from which he may then select the one he can use, or can modify for use. He will copy the selected suboperation on his own file (electronically) and there he may edit it or modify it as required.

Combined suboperations may be created and filed in the data base by making combinations of suboperations that are involved in the manufacture of some end product.

We now have a data base that is a source of material for the time standard program, or for the development of additional suboperations.

TIME STANDARD

A time standard is normally made up of a number of suboperations or combined suboperations, which may have different frequencies of occurrence, each of which is then modified by allowances for personal time, unavoidable delays, and human fatigue (usually referred to as P, F, & D) as well as an efficiency factor for a process time.

The time standard program is initiated with a header sheet that has a number of filing categories - similar to and for the same basic purpose as the titles in the data base program - and any other pertinent identifying or reference information. We then enter all the appropriate suboperation and/or combined suboperation locator numbers involved in the product, together with the proper frequency of occurrence for each one. The program will then prepare:

1. A METHOD INSTRUCTION - A step by step description of the work by suboperation title.
2. A TIME CALCULATION - A list of the steps in the standard, the frequency of occurrence assigned, the step time and the total time.

3. A RATE SHEET - A list of external manual times, internal times, and process times, showing the allowance percent, the allowance time,the standard time for each, the total standard time, the pieces per cycle, and the standard hours per piece.

The ability to produce those output documents makes the time standard program invaluable. We no longer need to have a large number of clerks turning out paper - nor do we need to maintain large file drawers full or records and documents. We can call up any of the documents we need in seconds -- and produce whatever hard copy we need at that time.

Another feature is the editing capability, which permits us to modify any individual standard as we make methods improvements or other changes. Engineering changes may be readily incorporated.

MASS UPDATE

The mass update program is another major convenience. Any time we find it necessary to change an element or suboperation that is common to many standards, or to change some assigned allowance, it would be laborious to make those changes either manually or one standard at a time. The mass update program allows us to identify the element to be changed, identify all the affected standards, and to make the change in all the standards simultaneously.

WORD PROCESSING

The word processing program has the added advantage of a special version specifically designed to produce the work management manual. It will not only produce the needed text material, but can literally pull any needed material from other MOST Computer Systems files for direct inclusion in the manual, without the need of retyping the data.

As with any word processing program,it has the basic advantage of permitting rapid editing and constant updating to provide real time MOST Computer Systems documentation.

THE MACHINING DATA PROGAM

The machining data program calculates process times for machining operations and documents the feeds and speeds for operator instructions. These values are to be used in conjunction with manual times and allowances in the time standards program to set standards for machine shop operations. (Figure 3)

The program determines the ideal speeds and feeds by using values recommended in the machining data file. The program selects feeds and speeds after considering the material used, tool, machine specifications, dimensions of raw and finished workpiece, etc. When the ideal speeds and feeds are not available due to machine limitations, the program allows you to select alternative speeds and feeds. This is an automatic procedure when the machine specifications have been included in the data file. The machining operations included in the program are drilling & milling and turning (single point tool).

Figure 3

```
   TYPE OF MACHINING .<H=HELP> ?
M
   ARE CUTTERS THE SAME <Y,N> ?
N
   TYPE OF MILL <H=HELP> ?
SIM
   LENGTH FACTOR <1, 2, 3,  H=HELP> ?
1
   LENGTH ?
6
   DEPTH PERPENDICULAR T0 THE AXIS (WIDTH) ?
2
   CUTTER DIA ?
5
   NO, OF TEETH ?
8
   TOTAL DEPTH CUT PARALLEL TO THE AXIS ?
2.
   CUTTER MATERIAL <S,C,H=HELP> ?
C

**********************************************************************
SPEEDS AND FEEDS FOR MILLING

   CUT     SPEED    RPM     DEPTH      FEED       TIME
    *      FT/MIN           INCHES     IN/TOOTH   TMU   IPM    TC EFF

R   1       312     238     0.2000     0.0075     950.  14.3      23.88
   TYPE OF MILL <:H=HELP> ?
SIM
   LENGTH FACTOR <l , 2 , 3, H=HELP> ?
1
   LENGTH ?
4
   DEPTH PERPENDICULAR TO THE AXIS (WIDTH) ?
1
   CUTTER DIA?
3.5
   NO. OF TEETH ?
6
   TOTAL DEPTH CUT PARALLEL TO THE AXIS ?
l 15
   CUTTER MATERIAL <S,C,H-HELP> ?
C

**********************************************************************
SPEEDS AND FEEDS FOR MILLING

   CUT     SPEED    RPM     DEPTH      FEED       TlME
    *      FT/MIN           INCHES     IN/TOOTH   TMU   IPM    TC EFF

R   1      325      354     0.1500     0 . 0080   550.17  l7.o    10.64
   FEED RATE SELECTED = 5,0000 (SET 5. 0000)
```

THE WELDING PROGRAM

The welding program contains four basic files: Joint descriptions, electrode descriptions or specifications, the welding method or procedure, and the manual elements involved. We enter the appropriate information in each file that is associated with our operation. Examples from each file are found in Figures 4 and 5.

In order to create a welding process time, we only need to identify the joint code, and the method code (the method specifies the electrode). The program then processes the information in its files to calculate the arc time (Figure 6) and the manual time. The result is reported out in a format that may be converted into a suboperation and placed in the data base.

Both the machining data program and the welding program are options in the sense that even without them, the analyst can determine process time by a manual formula, and enter those times in a suboperation, or directly in the time standard.

The creation of most suboperations with the computer program is, initially,slightly less time consuming than with the manual methods. However, as the data base is built up, more and more reference to existing suboperations will reduce the need for creating new method descriptions from scratch.

Figure 4

IDENTIFICATION	: PTlS.l-0-5/16
OUTPUT TO PRINTER ? N	
JOINT TYPE	: FILLET
OVERWELD (IN)	: 0.000
LEG 1 EXCL. OVERWELD (IN)	: 0.313
LEG 2 EXCL. OVERWELD (IN)	: 0.313
GAP (IN)	: 0.000
X'COMMAND (H-HELP) ? LM	
IDENTIFICATION	: ALL
OUTPUT TO PRINTER ? N	
IDENTIFICATION	: FILLET
OUTPUT TO PRINTER ? N	
METHOD TYPE	: NON-GROOVE
TOTAL NO, OF PASSES	: 1
ELECTRODE	: lE7018-06FF-0
VOLTAGE	: 24
CURRENT	: 225
IDENTIFICATION	: 1E701B-06FF-0
OUTPUT TO PRINTER ? N	
ELECTRODE TYPE	: ROD
MAX CURRENT (A)	: 225 l 00
MIN CURRENT (A)	• 225.00
DEP RATE AT 225.0 A(LB/HR):	4.87
DEP RATE AT 225.0 A<LB/HR):	4.87
ROD WEIGHT (LB/FT)	: 0.108300
RESTOCK COUNT	: 23
EFFECTIVE LENGTH (IN)	: 12.00

Figure 5

COMMAND <L,C,E,H=HELP> ? L

1	PREPARE & STRIKE	MANUAL-SHIP	32001	300.0000000
2	PREPARE & STRIKE	MANUAL-SHOP	32002	1300.0000000
3	PREPARE & STRIKE	SEMI-AUTO-SHIP	32003	3.0000000
4	PREPARE & STRIKE	SEMI-AUTO-SHOP	32004	1425.0000000
5	PREPARE & STRIKE	AUTO-SHIP	32005	5.0000000
6	PREFARE & STRIKE	AUTO-SHOP	32006	6.0000000
7	PREPARE & STRIKE	GOUGE-SHIP	32037	37.0000000
8	PREPARE & STRIKE	GOUGE-SHOP	32038	38.0000000
9	CHANGE ELECTRODE	MANUAL-SHIP	32007	7 l 0000000
10	CHANGE ELECTRODE	MANUAL-SHOP	32008	250.0000000
11	CHANGE ELECTRODE	SEMI-AUTO-SHIP	32009	9.0000000
12	CHANGE ELECTRODE	SEMI-AUTO-SHOP	32010	12680.0000000
13	CHANGE ELECTRODE	AUTO-SHIP	32011	11.0000000
14	CHANGE ELECTRODE	AUTO-SHOP	32012	12.0000000
15	CHANGE ELECTRODE	GOUGE-SHIP	32039	39.0000000
16	CHANGE ELECTRODE	GOUGE-SHOP	32040	40.0000000
17	DESLAG	MANUAL-SHIP	32013	13.0000000
18	DESLAG	MANUAL-SHOP	32014	590.0000000
19	DESLAG	SEMI-AUTO-SHIP	32015	15.0000000
20	DESLAG	SEMI-AUTO-SHOP	32016	885.0000000
21	DESLAG	AUTO-SHIP	32017	17.0000000
22	DESLAG	AUTO-SHOP	31018	18.0000000
23	DESLAG	GOUGE-SHIP	32041	41.0000000
24	DESLAG	GOUGE-SHOP	32042	42.0000000
25	WIRE BRUSH	MANUAL-SHIP	32019	19.0000000
26	WIRE BRUSH	MANUAL-SHOP	32020	540.0000000
27	WIRE BRUSH	SEMI-AUTO-SHIP	32021	21.0000000
28	WIRE BRUSH	SEMI-AUTO-SHOP	32022	810.0000000
29	WIRE BRUSH	AUTO-SHIP	32023	23.0000000
30	WIRE BRUSH	AUTO-SHOP	32024	24.0000000
31	WIRE BRUSH	GOUGE-SHIP	32043	43.0000000
32	WIRE BRUSH	GOUGE-SHOP	32044	44.0000000
33	RESTOCK	MANUAL-SHIP	32025	25.0000000
34	RESTOCK	MANUAL-SHOP	32026	89.0000000
35	RESTOCK	SEMI-AUTO-SHIP	0	0.0000000
36	RESTOCK	SEMI-AUTO-SHOP	0	0.0000000
37	RESTOCK	AUTO-SHIP	0	0.0000000
38	RESTOCK	AUTO-SHOP	0	0.0000000
39	RESTOCK	GOUGE-SHIP	32045	45.0000000
40	RESTOCK	GOUGE-SHOP	32046	46.0000000
41	SET UP	MANUAL-SHIP	32031	1.1000000
42	SET UP	MANUAL-SHOP	32032	1.0330000
43	SET UP	SEMI-AUTO-SHIP	32033	1.1000000
44	SET UP	SEMI-AUTO-SHOP	32034	1.0330000
45	SET UP	AUTO-SHIP	32035	1.1000000
46	SET UP	AUTO-SHOP	32036	1.1000000
47	SET UP	GOUGE-SHIP	32047	1.1000000
48	SET UP	GOUGE-SHOP	32048	1.1000000
49	WELD LENGTH PER ARC-STRIKE (SEMI-AUTO)			1.5000000
50	EXTRA OVERWELD WIDTH FOR S G B R J SS GS BS RS JS			0.1250000
51	DEFAULT BASE METAL DENSITY (LB/FT3) FOR GOUGE ELECTRODE'			489.5400085
52	COMMENTS			0.0000000
53	TEXT			0.0000000

Figure 6

```
XCOMMAND (H=HELP) ? CA
OUTPUT TO PRINTER ? N
.JOINT ID                 : PT1S.l-O-5/16
METHOD ID                 : FILLET
LENGTH ( IN)              : 1
SHIP(I) OR SHOP(O)        : 0

==============================================================================

STEP 1:  PT1S.l-o-5/16,    1.0 IN LONG, IN  1 PASSES (FILLET)
    0.58781 CUBIC INCHES PER FOOT

ELECTRODE          VOLT   AMPS  WIRE SP. TRAVEL SP  EL.CH.    ARC TIME (TMU)
---------------------------------------------------------------------------
lE7018-06FF-0       24     225              5.9      0.1282         285.

==============================================================================

TOTAL MANUAL AND ARC TIME -      36.
```

Beyond the initial data preparation, the computer system is unequalled in terms of its ability to create time standards and the needed documentation for implementation. The facility for maintaining up-to-date data, making revisions, and accessing the files is far superior to any manual system of filing or using the data.

To accomodate the special needs of the shipbuilding industry -- with its large products encompassing many thousands of manhours -- there are a few enhancements to the programs that are either in place, in process, or planned. Briefly these include:

A. Time Standard Summary - This feature is presently included in the software. Given specific ship component coding, it is possible to request a list of all standards on file that pertain to a given piece of work (a hull section, a deckhouse, or even the whole ship), The result is a title listing of all the standards involved, a statement of the number of standards involved, and the total standard hours for the defined work. In other words, a summary time for any specified code or construction level of the ship.

B. Real Time Work Standards - This enhancement is planned, and involves the modification of a given time standard for real time planning purposes - and/or for estimating.

Since the shipbuilding industry has not traditionally used engineered time standards, we must carefully define the level of application to be used, and the method of using the standards. First we must realize that the time standard produced through MOST Computer Systems is a labor standard. This standard defines the time required to accomplish a defined piece of work when the operator is working at the 100% performance level, and when there are no unavoidable delays or non-work events.

C. Maxi MOST - For measuring large scale fabrication and assembly operations.

PRACTICAL APPLICATIONS OF MOST

Whether we want to modify the labor standard for performance or other factors, depends directly on the way we intend to use the standard. We need to identify the various areas of application for time standards. The following lists include most of the applications, divided in three basic shipyard functions.

1. INDUSTRIAL/MANUFACTURING/PRODUCTION ENGINEERING
   a. Methods Improvement
   b. Tool, Equipment and Machinery Evaluation
   c. Facility Layout, Flow and Workplace Arrangement
   c. Productivity Improvement Through Delay Identification and Elimination
   e. Manning - Balancing and Critical Path Determination
   f. Labor Incentives
   g. Make/Buy Anaylses
   h. Long Range Facilities Planning

2. PRODUCTION
   a. Supervisory Control
   b. Manpower Distribution and Assignment
   c. Labor Performance Reporting and Analysis
   d. Productivity Improvement

3. PRODUCTION PLANNING, SCHEDULING AND CONTROL
   a. Labor Budgeting
   b. Shop Scheduling
   c. Critical Path Development

d. Material Requirements Planning (when and where)

e. Estimating

Now let's take a look at the various outputs of MOST Computer Systems - and see where they are used in the application areas.

1. MOST Program -

   Work area layouts. The defined work area incorporating the space, workplaces, objects, tools, equipment and carriers used to perform specific work.

   Method steps. The exact description of an element of work in the work area.

   These outputs can be directly used for applications la, lb, and lc.

2. The Data Base program -

   o Suboperations. A group of method steps required to complete a specific task or operation at a work area.

   o Combined Suboperations. A group of suboperations required to produce a specific component, subassembly, assembly or product.

   o Process Time. The'time required for a machine or process monitored by an operator. This calculation is usually determined by time study or from special tables or from the welding and machining programs.

These outputs can be directly used for applications la, lb, lc, le, and lg.

3. The Time Standard Program -

Time Standards. Combined suboperation and appropriate process time(s) plus allowances for personal time (P = washroom, coffee break, etc.) human fatigue (F) unavoidable delay (D = Foreman instructions, multi-operator interaction, safety meetings, etc.) and process efficiency (e.g.,, machine operating variations, welding process modifications, etc.). The time standard defines the time required to perform a predetermined amount of work at the 100% performance level.

These outputs can be directly used for applications (1) all, and (2) all.

4. Application Standards -

A modification of a time standard to account for real world situations. Application standards are derived by applying temporary (revisable) allowances to time standards. The temporary allowances account for such events as crane or material handling delays, material shortage delays, crew imbalances, actual labor performance (i.e., performance will improve from 20% to 60% over the first five ships of a class) and "uncertainty" factors for estimating purposes. (Uncertainty factors would include evaluations of increases or decreases in work content of a new ship in comparison to a ship for which there are existing standards, and expected patterns of material flow, etc.)

These application standards are used for applications Id, le, lh, 2b, 2c, 2d, and 3 all.

We are now considering an enhancement to the time standard program, to permit a second level (or even a third level) of time standards -- the application standard -- to be developed within the program by using appropriate allowances. The proper application of the mass update program will permit us to maintain the application allowances at whatever real world state we wish. Under any circumstances, we must use these allowances manually in order to arrive at standards that are usable by the planning and control functions of the shipyard.

5. An enhancement in the process of being finalized (and it is really a further development of MOST Systems is Maxi MOST.

In spite of the fact that MOST Systems of standards development gives us the ability to produce valid standards for long cycle and non-repetitive operations with a minimum investment in analyst time, there is always the call for something even faster. It is not unexpected that members of the shipbuilding industry are in the vanguard of those companies seeking such a goal.

Toward that end, H.B. Maynard and Company has been working with two clients to develop an advanced version of MOST for use in "heavy" industry. One client is a manufacturer of large trucks, and the other is a shipyard.

The system is called Maxi MOST, and utilizes five basic sequences: three for manual activities, and two for material handling. In Maxi MOST, the index values are ten times larger than those used for Basic MOST, Thus implying that each method step in Maxi MOST would cover ten times the work as each step of Basic MOST -- and thus be ten times faster to apply. It is probably more realistic to say that the application speed of Maxi MOST is about five times faster than that of Basic MOST

The system itself has been developed and applied manually for about six months, and has been fairly well debugged. At this point in time, the computer version has been developed, and testing was initiated just over two weeks ago. It is anticipated that the computer module for Maxi MOST will be fully debugged and ready for general use before the end of this year.

During the debugging period, evaluations are being made to define the levels of accuracy that can be expected -- relative to the work cycle time and the balancing time of the system. There is no doubt in our mind that Maxi MOST has great potential in the majority of shipyard construction and erection operations.

In summation, MOST Computer Systems is a powerful tool for the shipyard -- one that enables us to set engineered time standards for any yard operation rapidly and accurately. The use of the computer enables us to file, review, adjust, and synthesize a vast amount of data within a short time period - and with relatively little manpower. It provides the ability to produce updated and effective end use documents on command. Finally, it provides a solid basis for linkage to an overall management information system. It provides the essential element of sound labor reporting, evaluation and control that has the major impact on shipyard cost.

With reference to the Japanese success story, they are in fact using most of the classical I.E. functions, such as: methods improvement, development of special jigs and fixtures, process flow improvement, production standards development, and line balancing. The work is being done through the services of "Production Engineers" assigned to each major area of the shipyard -- men with degrees in naval architecture or engineering.

Further, the Japanese have had the advantage of building large numbers of similar type ships. One result is that they have been able to refine their "historical" standards and key them to such parameters as total weld length, feet of pipe, and total weight. Since those parameters have some significance on similar ships, they have also developed the special factors and allowances relected in their operations -- and they use those predetermined standards for planning, estimating, budgeting, etc.

The MOST Computer Systems programs that we have described give us in the United States the opportunity to develop predetermined standards specifically designed for the onesy-twosey type of operations that dominates our shipbuilding. It also provides a much more effective means of identifying those nonproductive operations and those delays that we can exert effort to eliminate, and make radical improvements in our productivity.

As a result, we are getting the hands on experience needed to prove the value of MOST Computer Systems in the shipyard. Through the SNAME SF-8 Panel Industrial Engineering Program, the potential uses of MOST Computer Systems in the shipyard are being tested and applied. By the end of the current program year, it is expected that the data development and program refinement work will be complete. There will be sufficient data to validate the expectations, and to define the planned applications of labor standards in shipyard operations for next year's program.

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